CHAPTER 10. CONSUMER SUB-GROUP ANALYSIS

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CHAPTER 10. CONSUMER SUB-GROUP ANALYSIS

10.1 SUMMARY OF RESULTS

The Consumer Sub-Group (CSG) analysis examines the economic impacts from possible revisions to U.S. residential water heater energy-efficiency standards on different population groups of consumers. The analysis determines whether or not a particular segment of consumers would be adversely affected by different trial standard levels in terms of increased life-cycle cost (LCC) of equipment. We also calculate the fraction of the population that would benefit from particular trial standard levels (in terms of LCC).

Of particular interest is the potential effect of standards on low-income households and on senior-only residences—two consumer sub-groups of interest identified by stakeholders at the November 1998 U.S. Department of Energy (DOE) workshop. From the results of the CSG shown in Table 10.1 below, both senior-only and low-income households benefit from the energy savings projected to result from most trial standard levels for electric and gas-fired water heaters. The percent winners column refers to the fraction of the population which benefits from the trial standard level. Please refer to the Life-Cycle Cost Analysis (Chapter 9) for details and features of the trial standards.

Table 10.1 Summary of Delta LCC Results [a]

Product Class	Trial Standard Level	Total Sample Delta LCC		Low-Income Delta LCC		Senior-Only Delta LCC	
		Ave. (1998$)	Fraction of Population Benefitting (%)	Ave. (1998$)	Fraction of Population Benefitting (%)	Ave. (1998$)	Fraction of Population Benefitting (%)
Electric	1	36	90	35	90	39	92
	2	32	68	28	67	39	72
	3	23	59	7	54	33	64
	4	-82	26	-105	22	-60	31
Natural Gas	1,3	30	78	30	78	34	82
	2	11	64	-1	55	17	68
	4	-244	18	-268	15	-194	20
LPG	1,3	97	89	110	93	108	92
	2	77	78	88	80	87	80
	4	-122	37	-53	37	-34	38

[a] We did not update the oil-fired analysis when the RECS 1997[1] data became available because only a small number of households use oil-fired water heaters and the standard for oil-fired water heaters is not being changed.

10.2 DATA USED IN THE ANALYSIS

Variations in water heater energy use among households depend on the following factors: number and age of people in a household, size and type of water heater, climate, and presence of hot-water-using appliances. We estimated annual energy use for several thousand households. The models are derived from test procedures and field measurements. We used 1997 Residential Energy

Consumption Survey (RECS)[1] data for household characteristics in combination with a water-use equation and an energy use equation (WHAM, see Chapter 9.3) to calculate hot water use, energy consumption, and fuel price. With data from 3,617 of the 5,900 RECS households, we accounted for the variability of factors between households that affect water heater energy-use in the residential sector. We used the same data-weighting factors as RECS to indicate how common each household configuration is in the general population. The methodology used for the CSG is the same as for the LCC. In fact, the LCC spreadsheets were used with selected sub-groups of the total population. For a complete explanation, see Chapter 9. Table 10.2 shows the percent of households by consumer sub-group category and water heater fuel type.

The 3,617 households represent 63,785,000 households in the United States, 63% of the total households. The households used in our analysis have the following features: (1) running hot water; (2) a water heater that provides hot water to a single-family housing unit; (3) use of one of four fuels (natural gas, LPG, fuel oil, or electricity) for water heating; (4) billing information that permitted us to calculate the marginal fuel or electric rate; and (5) information on water heater size.

Table 10.2 Households by Consumer Sub-Group Category and Water Heater Fuel

Percent of Total Population	Nat'l Gas	Electricity	LPG	Fuel Oil	All Fuels
Low-Income Households	6.6%	6.2%	0.6%	0.1%	13.5%
Low-Income and Renting	3.2%	2.7%	0.1%	0.0%	6.1%
Senior-Only Households	7.6%	8.7%	0.8%	0.6%	17.6%
Senior-Only and/or Low-Income	13.0%	13.2%	1.2%	0.6%	28.0%

10.3 LIFE-CYCLE COST DETERMINATION

DOE uses LCC to determine consumer impacts. LCC is the total consumer cost over the life of a water heater, including (1) purchase price, (2) installation cost, and (3) operating cost. We obtained the purchase price and installation costs of baseline model water heaters from a database of retail stores and wholesale water heater distributors (see Chapter 5). The operating cost calculation requires three inputs: (1) the quantity of hot water used, (2) the amount of energy used, and (3) the energy price.

Operating cost is largely determined by the amount of hot water used by a household. The amount of hot water used varies widely among households; it depends on: (1) the number, age, and employment status of the people who live in the home; (2) the climate in which the home is situated; (3) the presence of hot-water-using appliances; (4) the tank size and thermostat setpoint of the water heater; and (5) whether the household pays for the water-heating fuel. Using these five characteristics, we calculated average daily hot water use for each household in our sample. Figure 10.1 shows the average number of people in homes by region of the country. Figure 10.2 shows the variation in average water heater thermostat setpoint temperature in the United States. The water heater thermostat setpoint determines the temperature to which the water must be heated. People with colder cold water tend to turn up their water heater thermostat settings. Figure 10.3 shows

average daily hot water use per person across the U.S. The average daily hot water use and the water heater characteristics determine the energy use, which is combined with the energy cost to calculate the operating cost.

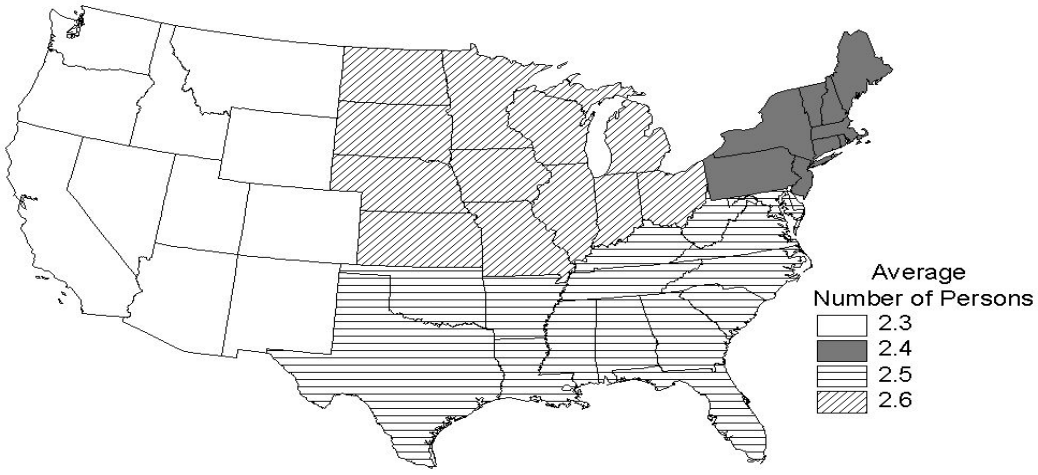

Figure 10.1 Average Number of People Per Household

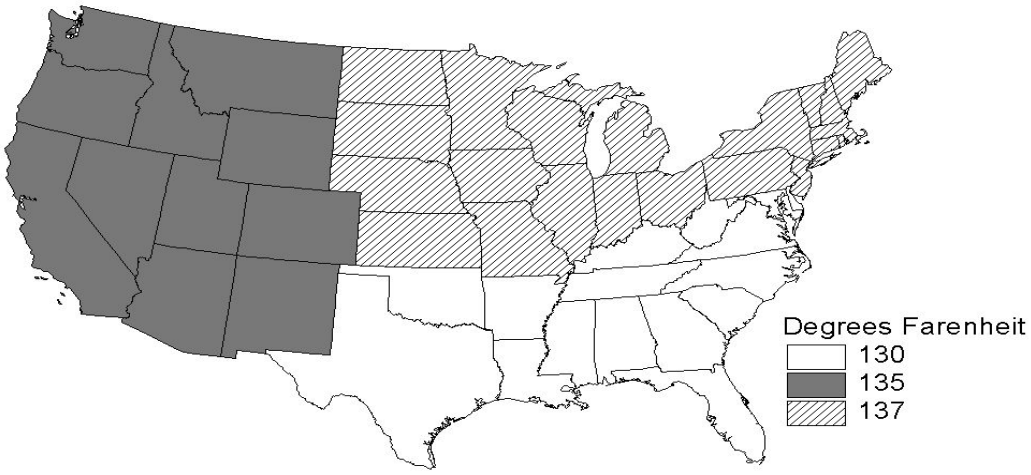

Figure 10.2 Average Water Heater Thermostat Setpoint Temperature

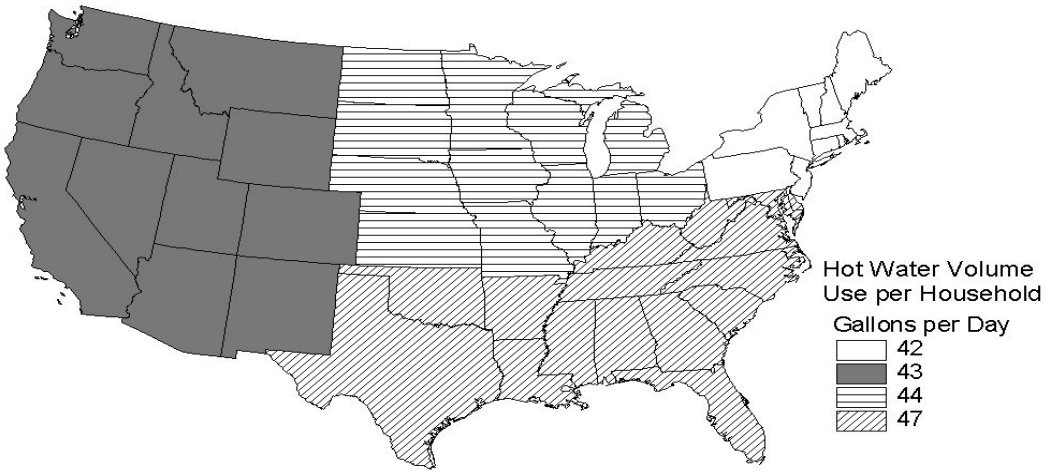

Figure 10.3 Average Daily Hot Water Volume per Household

By comparing the LCC of all consumers to the LCC of the two consumer sub-groups of interest, we can determine whether the proposed trial standards affect those sub-groups differently. DOE determined that low-income and senior-only households were sub-groups that might be adversely affected by trial standards; DOE also determined which trial standard levels might have adverse impacts on these subgroups. Figures 10.4 and 10.5 show the distribution of low-income and senior-only households throughout the country. Figures 10.6 through 10.14 show the baseline water heater life-cycle costs for three population groups for electric, natural gas, LPG, and oil water heaters: the entire sample population, low-income households, and senior-only households.

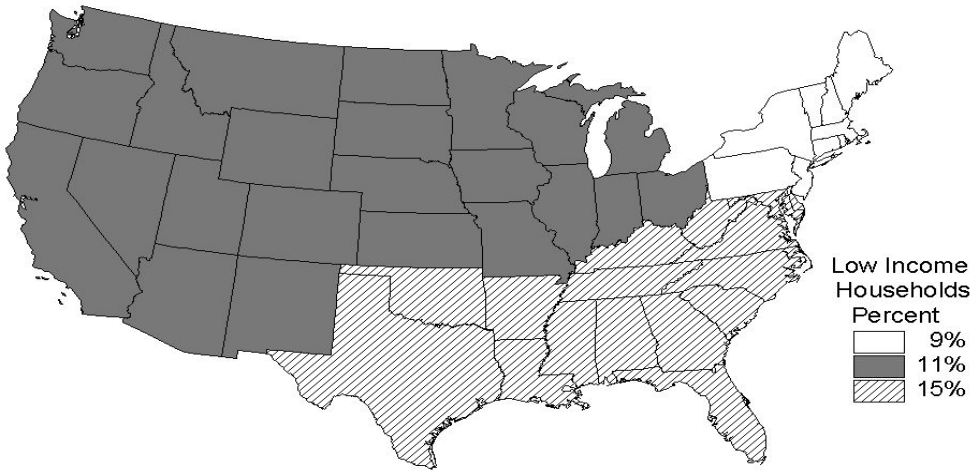

Figure 10.4 Percentage of Low-Income Households by Census Region

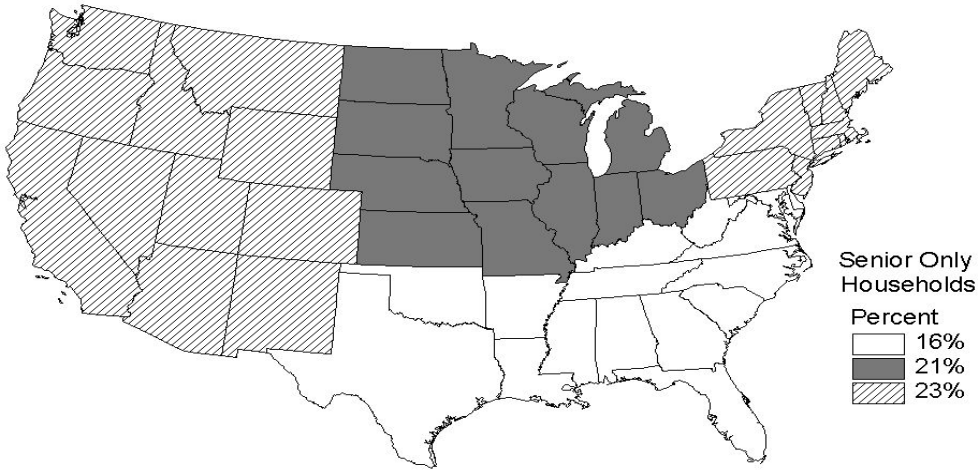

Figure 10.5 Percentage of Senior-Only Households by Census Region

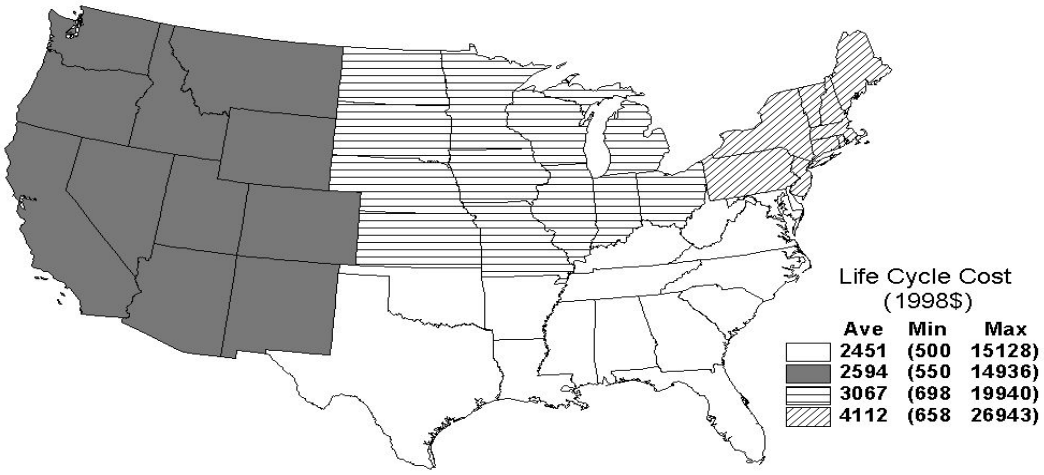

Figure 10.6 Life-Cycle Cost for All Households in Sample — Baseline Electric Water Heater

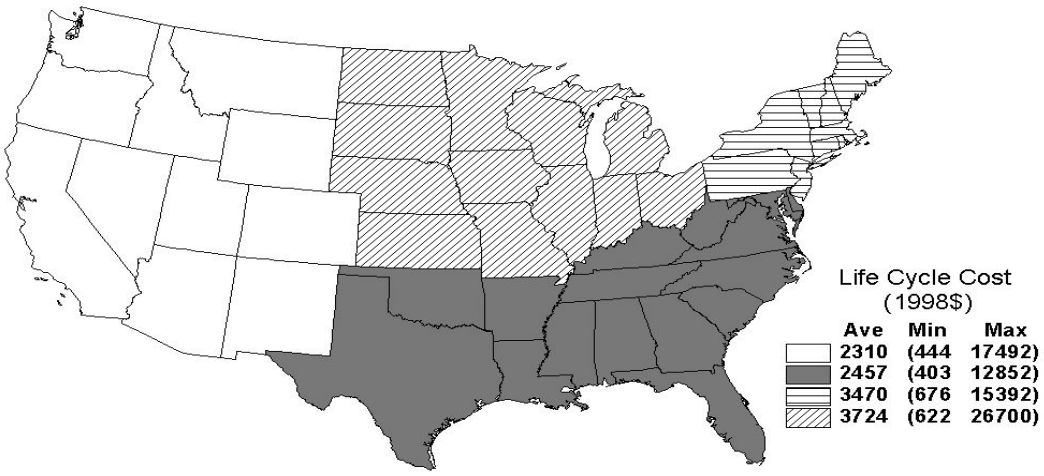

Figure 10.7 Life-Cycle Cost for Low-Income Households — Baseline Electric Water Heater

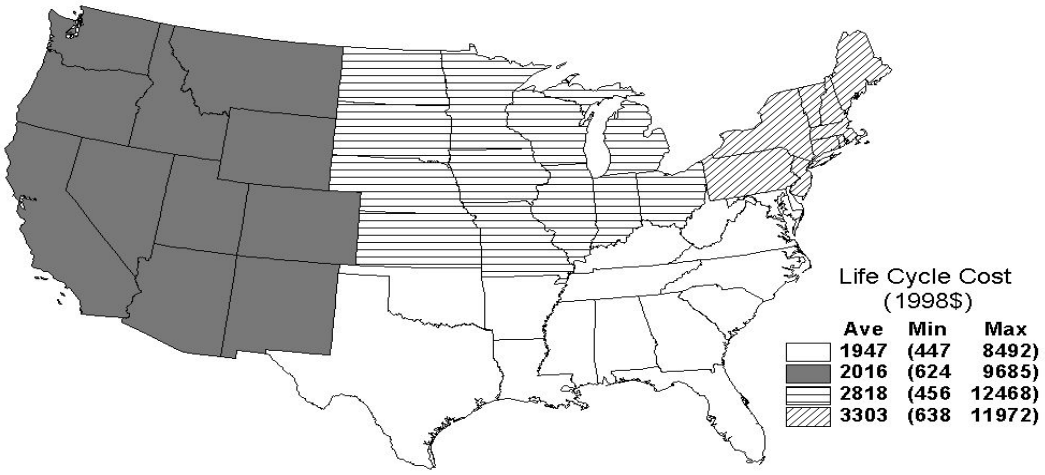

Figure 10.8 Life-Cycle Cost for Senior-Only Households — Baseline Electric Water Heater

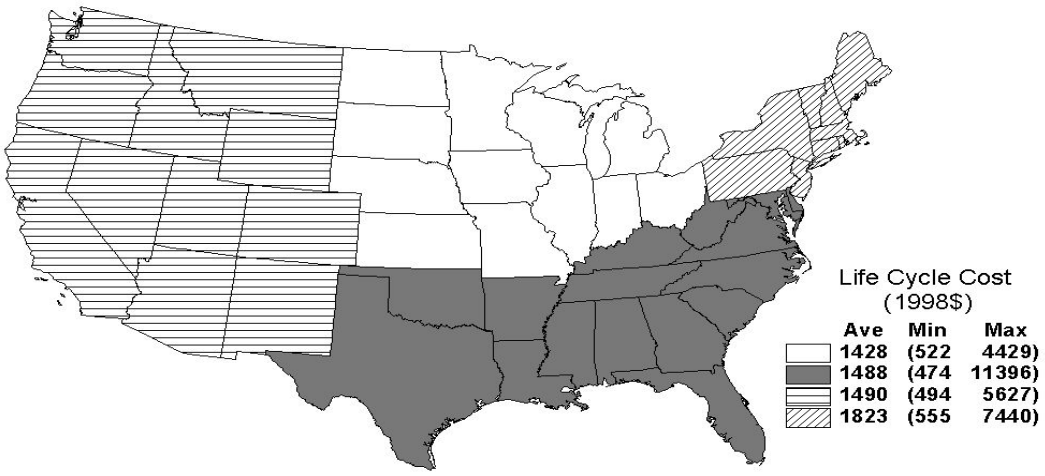

Figure 10.9 Life-Cycle Cost for All Households in Sample — Baseline Gas Water Heater

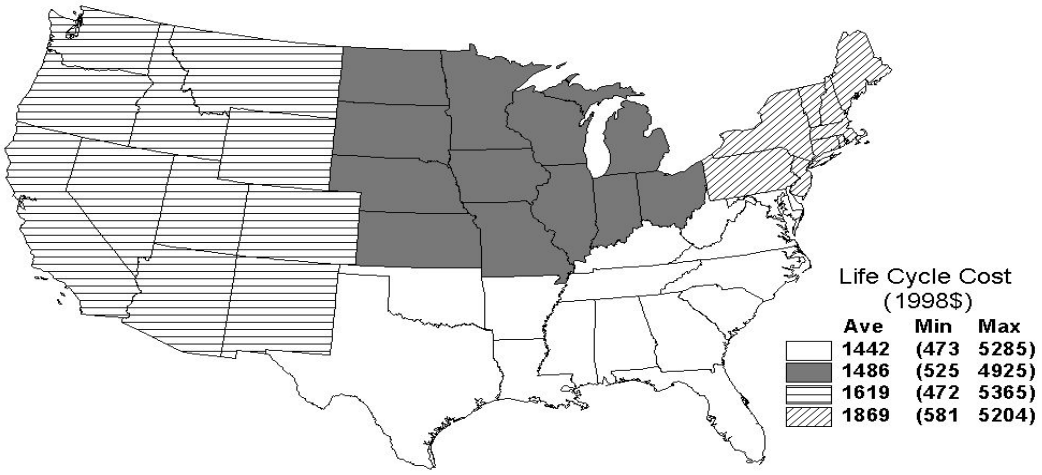

Figure 10.10 Life-Cycle Cost for Low-Income Households — Baseline Gas Water Heater

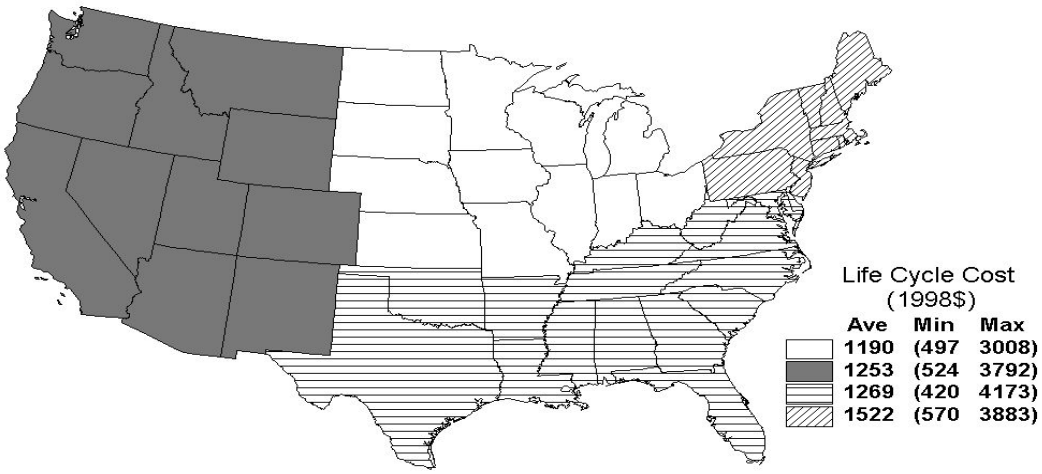

Figure 10.11 Life-Cycle Cost for Senior-Only Households — Baseline Gas Water Heater

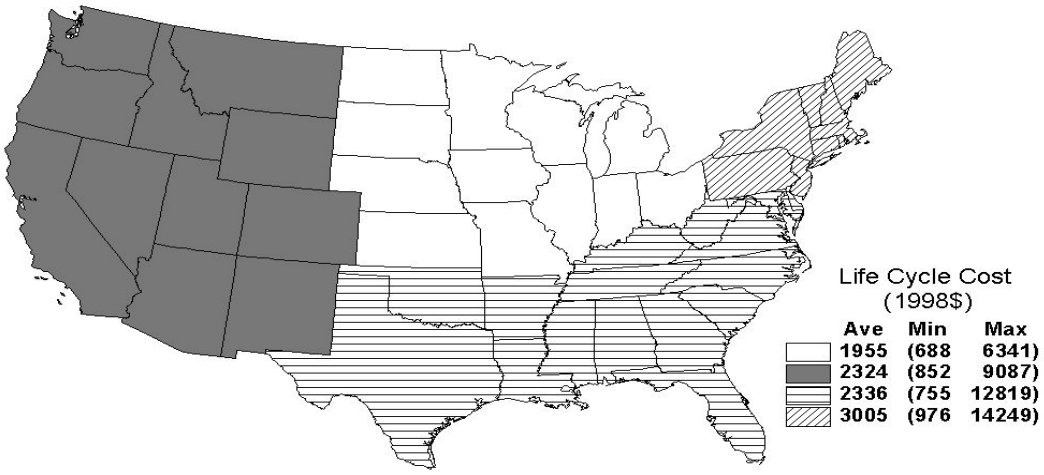

Figure 10.12 Life-Cycle Cost for All Households in Sample — Baseline LPG Water Heater

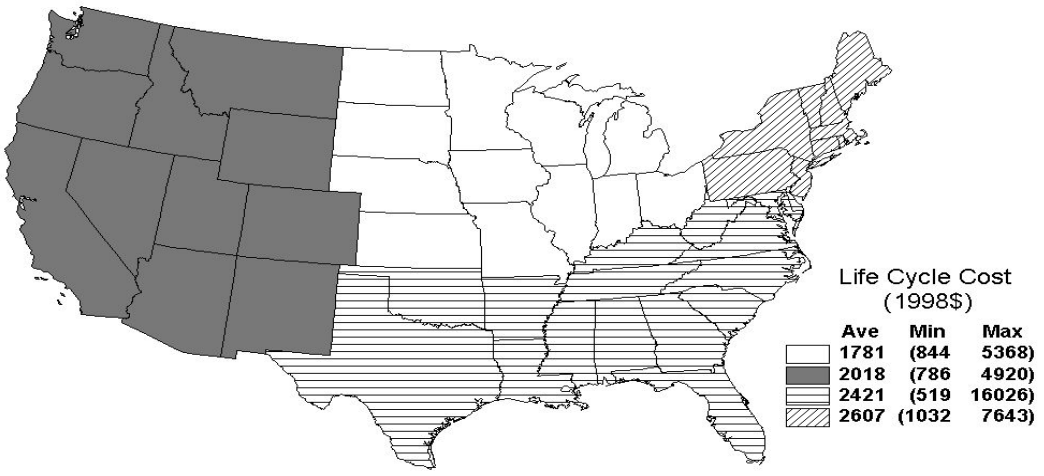

Figure 10.13 Life-Cycle Cost for Low-Income Households — Baseline LPG Water Heater

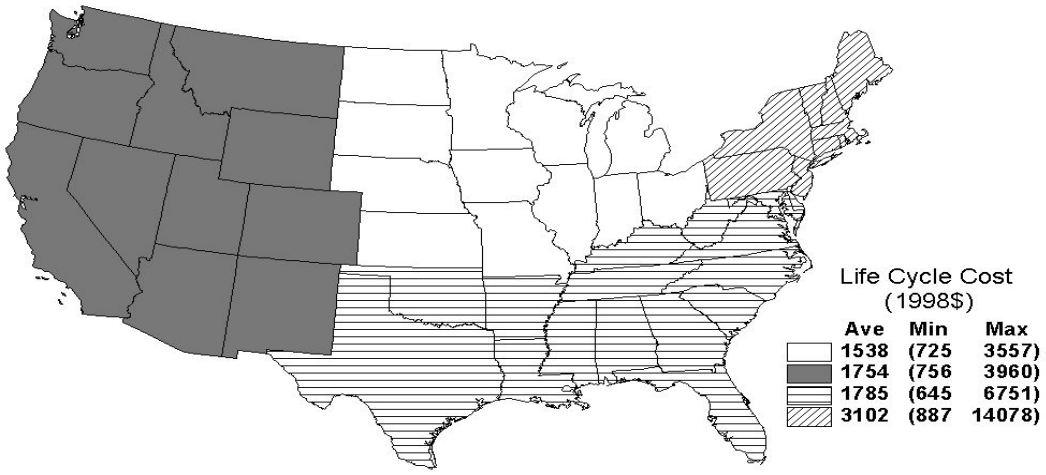

Figure 10.14 Life-Cycle Cost for Senior-Only Households — Baseline LPG Water Heater

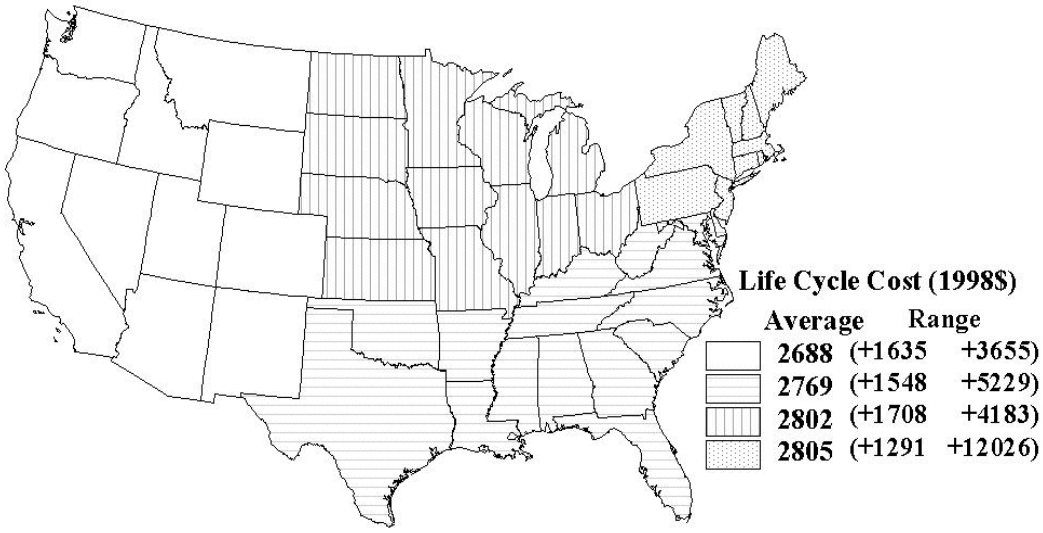

Figure 10.15 Life-Cycle Cost for All Households in Sample — Baseline Oil Water Heater

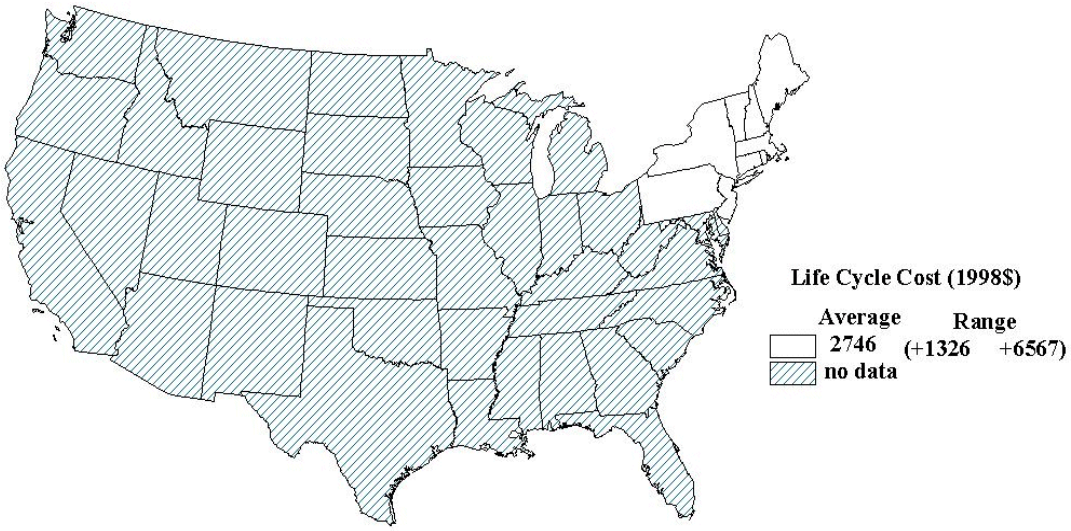

Figure 10.16 Life-Cycle Cost for Low-Income Households — Baseline Oil Water Heater

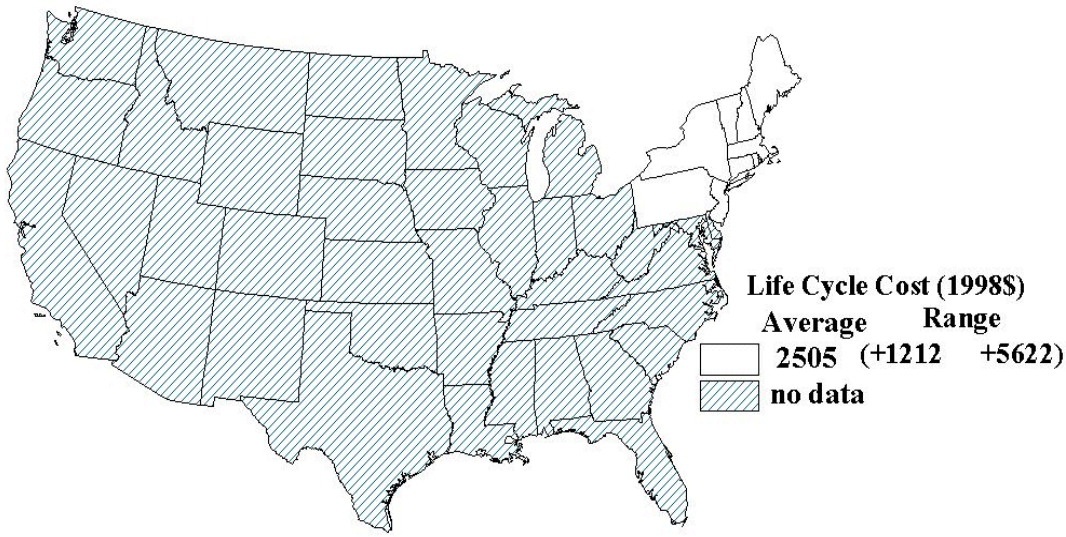

Figure 10.17 Life-Cycle Cost for Senior-Only Households — Baseline Oil Water Heater

Figures 10.18 through 10.23 show the changes in life-cycle costs for the entire sample population, for low-income households, and for senior-only households. The trial standard level shown is level Three. Electric water heating households are represented in the first three maps; and natural gas follow. Savings are indicated by negative numbers. The trial standard levels are explained in Chapter 9.

For electric water heating households, the delta life-cycle cost (DLCC) for both low-income and senior-only households shows a higher savings when compared to the total sample.

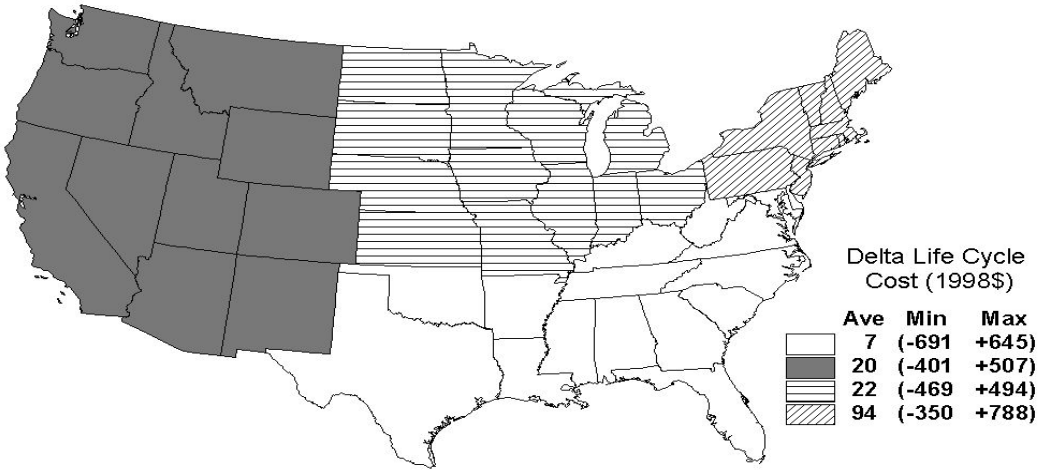

Figure 10.18 Delta Life-Cycle Cost for All Electric Households in Sample — Trail Standard 3

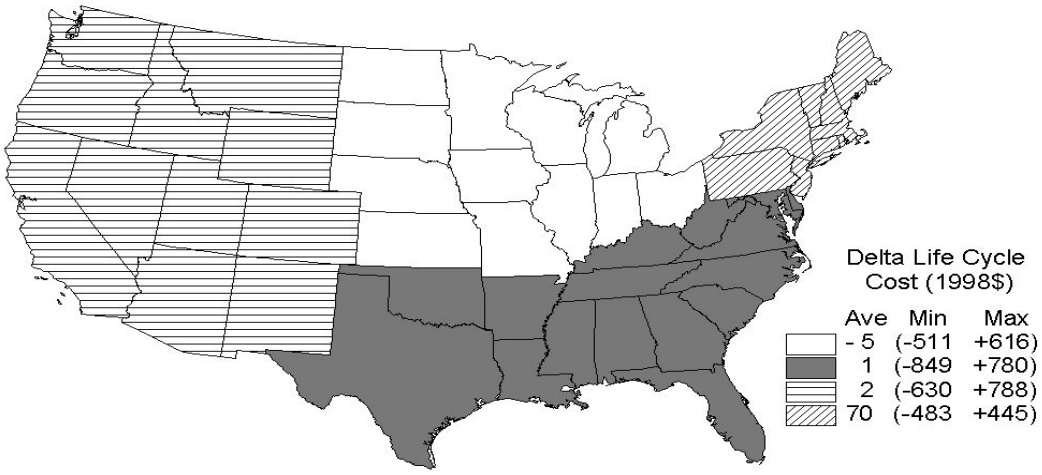

Figure 10.19 Delta Life-Cycle Cost for Low-Income Electric Households — Trial Standard 3

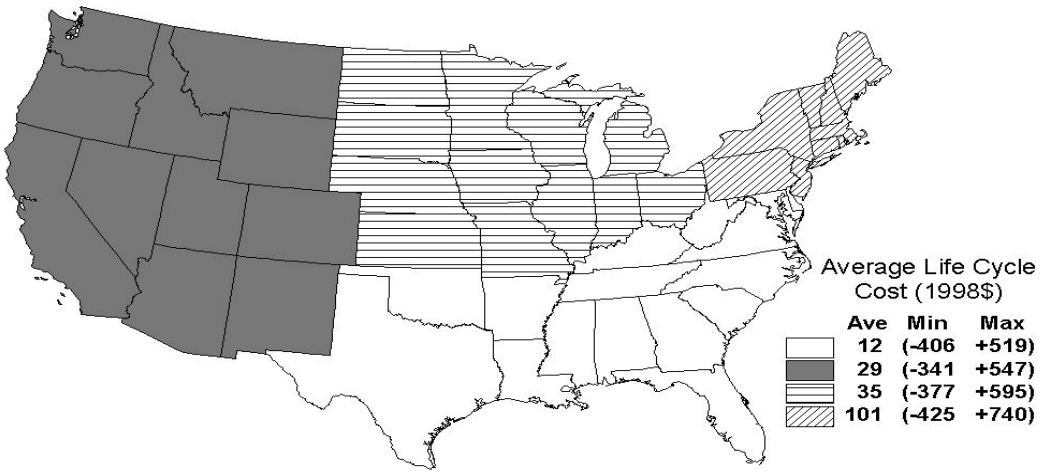

Figure 10.20 Delta Life-Cycle Cost for Senior-Only Electric Households — Trial Standard 3

For natural gas water heating households, all three maps show comparable savings.

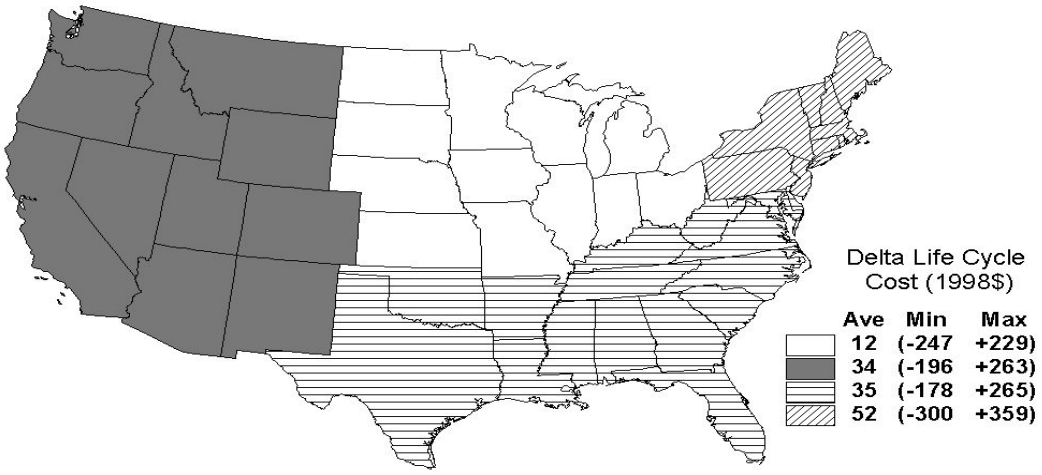

Figure 10.21 Delta Life-Cycle Cost for All Natural Gas Households in Sample - Trial Standard 3

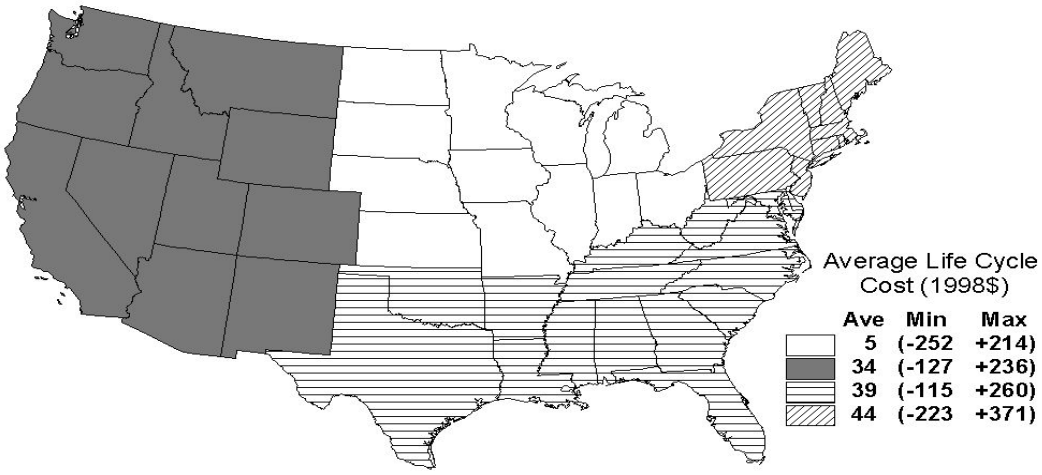

Figure 10.22 Delta Life-Cycle Cost for Low-Income Natural Gas Households - Trial Standard 3

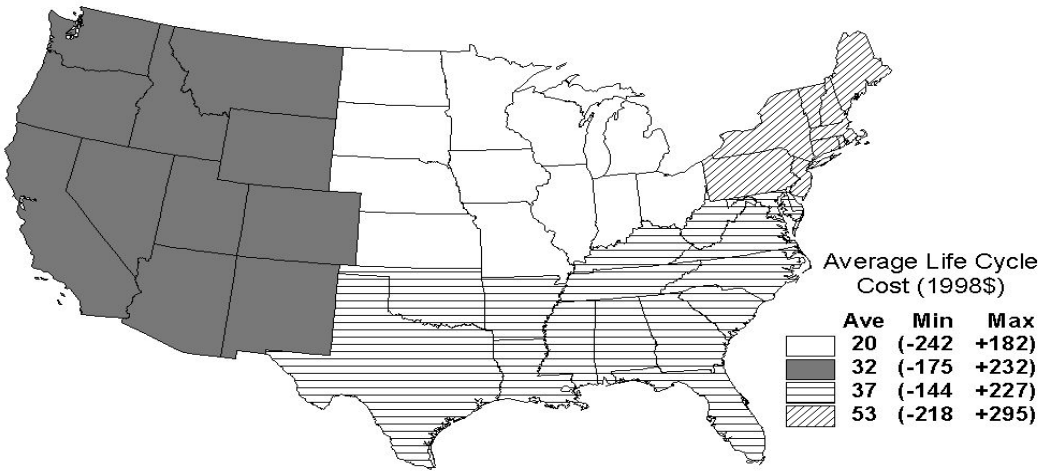

Figure 10.23 Delta Life-Cycle Cost for Senior-Only Natural Gas Households — Trial Standard 3

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1. U.S. Department of Energy - Energy Information Administration, *Residential Energy Consumption Survey: Household Energy Consumption and Expenditures 1997,*1999. <http://www.eia.doe.gov/emeu/recs/recs97/publicusefiles.html>